A 100-kg Class Titan Airplane Mission

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The combination of low gravity and high density of Titan's atmosphere makes powered, aerodynamic flight on that Saturnian moon energetically more favorable than at any other known location in the Solar System. Titan also possesses a relatively transparent atmosphere below ? 10 km altitude, which suggests that regional or global scale imaging of Titan's surface could be conducted by a small Unpiloted Aerial Vehicle (UAV). This paper discusses the engineering details of a point-design autonomous UAV for performing this mission capable of being delivered to Titan via an atmospheric entry probe. The probe payload consists of a 100 kg UAV with an L/D of ? 15. Such a vehicle could fly at 8 km altitude on Titan on ? 50 W of aerodynamic power (steady state). Taking into account reasonable allocations for propeller and electric motor efficiencies, such a vehicle could fly on ? _ the output of NASA's next generation radioisotope power generator--the Advanced Stirling Radioisotope Generator (ASRG). An ASRG powered Titan UAV could fly for an indefinite period--perhaps more than a year--and map the equivalent ground track of 20 circuits around Titan's equator. Alternatively, an aircraft of this type powered by stored chemical energy may have a lifetime of 1 or 2 days and fly a path of more than 1000 km. In addition to normal aircraft design requirements (lift/drag-weight/thrust equilibrium, weight and balance, etc.) UAV's intended for flight in the atmosphere of a celestial body other than Earth must be folded to fit into the shape and volume of an entry probe and must have provision for autonomous, mid-air unfolding prior to beginning of flight. A conceptual UAV-entry vehicle design and supporting engineering calculations are presented.

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